

Analysis of Financial Crisis Causes and Complex Systems Scientific Methods

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Abstract: The financial crisis is because money flows are blocked or interrupted, and gives two formulas. One formula is to calculate the speed of money flow, and another formula is the money demand and supply formula of the "nodes". The paper also presents methods for analyzing complex science, which economics is. The paper proposes several methods to analyze complex systems, such as "program" and "fractal".

Key words: financial crisis, money flow speed, complex scientific, program, fractal

foreword

For many years, the paradigm of studying science has been "reductionism," but reductionism is not very applicable to studying the social sciences. Social sciences are complex science, such as economics. Many of these places can be studied using methods of complex science. The reductionist plan stops in the face of many phenomena.^[1] (Melanie Michelle, 2018)

Complex science is a methodology, which corresponds to "reductionism". It began in the 1980s and has been extensively studied. But the vast majority of the ideas are from the local to the whole source, this paper puts forward an opposite idea, that is, from the whole to the part, from the whole analysis of the complex system.

The rate of money flow in Fisher's equation is about the entire economy, but the speed varies in different parts of the economy, such as in banks and workers' incomes. Therefore, this article discusses the rate of money flow in the micro part of the economy. The water flow in the water pipe cannot be congested or cut off, and money is like water. The congestion or cut off of money will produce economic and financial problems, which can be compared to the water flow.

1. Complex economics

In Complex Economics, Brian Arthur says, " Now, in science, including economics, researchers generally agree that the world we face is a world that is not completely orderly and, in principle, reduced to several mathematical equations; instead, it is largely organic and algorithmic, evolving based on an already established system. For all these reasons, a research path based on the above and more realistic assumptions has slowly emerged in economics. A new economic framework is taking shape."^[2] ("Complex Economics")

So there are also some people in the economics world who are changing their research methods, abandoning reductionism, and viewing the economy from the perspective of complex science.

In this passage, Brian Arthur mentions: ".....Algorithm,..." shows that he has realized that there is an "algorithm" method for complex science, and that "algorithm" means very similar to the "program" mentioned later in the article.

"Complex system is the multiple elements that compose the system to adapt or respond to patterns created by the elements themselves. Elements in a complex system can refer to cells in a cellular automaton, or a car in a transportation system that responds to the state of adjacent units, and the latter to the car in front of or behind it. Of course, the "elements" and the "patterns" they respond to vary in different contexts. But in any case, the elements must adapt to the world they create, the overall pattern. Here, time naturally enters the system through adjustment and change: as the elements react, and the total changes, and the elements react again."^[3] Brian Arthur's passage has begun to think from "the element" into the whole.^[3] (Complex

Science, page 13)

At present, almost all similar complex scientists think from the part to the whole.

Johnh Hollandd said in The Emergence:

"The definition of mechanisms needs to accu speedly describe the basic elements (the agents), the rules, and the interactions between the elements used to define a complex system. With this setting, we can eventually adopt a general approach." [4], Page 13)

For example, Richard Bookstaber says in The End of Theory (a book that studies economics with complex scientific methods):

"The simplest proxy base model for traffic is a cellular automaton model : if a cell is black, it is occupied by a car; if white, it is an open space on the road. Each car is an agent, and the inspiration for all agents is simple and identical : if there is an open space in front of a car, it enters that space; otherwise, it stops until the car in front moves and the space is open ". [5] (P. 1845)

These are all from the "element", "agent" (local). It's like looking for a forest from the trees.

Contrary to this practice, the paper suggests that it should start in another direction. That is, from the overall analysis. Starting from the forest, looking for the "programs" in the forest.

From the economy as a whole, but not from the "subject". Instead of looking for the rules and rules of organizing the "individuals", they take the whole economy as the "subject" and analyze the "proprams of economic activity" from the whole, just like Quinnaeus. It starts with "forest", not from "trees".

Finding "emergence" from the interaction between individuals is unnecessary, and "emergence" is actually related to consciousness. An economy is an organism, and it is conscious. People are conscious, and therefore the operation of psychological programs is related to consciousness, but consciousness in the current science is difficult to study. Therefore, abandoning the research consciousness is advocated here.

2. program

Here "program" does not mean "computer program", but a sequence of a series of operations or behavioral steps. It means close to "process", "algorithms," etc. This concept is proposed by analogy with the concept of "computer program". Human psychology is program, economic activity is program, and biological physiological activity is also program. Although these three programs are not computer programs, they are very similar to computers.

Here's an example, Francois Quesnay's economic table. As a doctor, Quinnai sees the economy as a huge organism, and the precious economic surplus is like a blood supply function vital to life. To explain this view, he made the first economic "model" (model), a simplified economic map. Quinnay created it in his original book, The Economic Table (Economic chart). He outlined many curves to represent the resources circulating around the economy. The peasants produced the economic surplus and paid the rent to the nobles who owned the land, who then bought the silk buttons and the silver candlesticks from the hand craftsmen. The craftsmen in turn bought food from the farmers to complete a cycle. The economy is a kind of surplus circulation formed between the peasants, the landlords and the hand craftsmen. [6] ,

This economic table can be written as the following program diagram:

Farmers' production and economic surplus → Pay the rent to the nobles who own the land → The nobles then bought silk buttons and silver candlesticks from the hand

craftsmen→The craftsmen in turn bought food from the farmers .^[10]

This is actually the program block diagram. If we see the economy as a whole, and then we analyze it, the economic activity takes steps like this program chart. With enough information, you can analyze these "steps" of economic activity, and then analyze such "steps" for any problems.

In complex science, there have been many references to concepts like "programs".

Here is the John E. In Mayfield's book, The Engine of Complexity:

"A corresponding principle is that the apparent impossibility of complex things of life and technology reflects the amount of additional information needed to form them. This is reflected in all human beings and the non-living products of life and human creation. The more information it needs to form something, the more unlikely it appears. For example, compare stone axes and supercomputers, or viruses and humans. The more complex and less likely things are, the more information you need to create them. This description of information is expressed in the form of a blueprint, formula, gene (DNA or RNA), or collectively known as instructions. Instruction can be in various forms, but a simple definition may be as this: " the instruction is a specific coding information, with the following attributes, when used to change another system in order, can get a predetermined final result, and for someone or something, creating the instruction brings some benefits or want something."The instruction contains purposeful information. They are created because their products can bring benefits to the creator. Instructions typically specify or pre-specify the steps and behaviors that another system needs to perform. The system can be either human or not. The completion of the steps leads to the achievement of a particular goal. Thus all instructions imply a target.

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The basic idea of instructions are familiar, and one example is the recipe. Custard cake is a food that only humans can make. To make a pastry, follow a series of precise and simple steps. Whenever these steps are followed, specific results are obtained. Here is an online recipe for egg milk pastry [1] :

1. Divide the 6 eggs into egg yolk and egg white.
2. Soluvate 1 / 4 cup of cream, mix 1 / 4 cup of flour, 1 teaspoon of salt, 1 / 4 teaspoon of mustard and a dash of chili powder. Heat up and stir for 2 minutes.
- 3 Add 11 / 2 cup of milk slowly and stir continuously until smooth. Heat for 2 minutes, stir continuously, then stop heating, add 1 cup of crushed yellow cheese and stir well.
4. Beat the egg yolks, add a few tablespoons of hot cheese sauce, heat the egg yolks, and then add them to the cheese sauce.
5. Stir the protein in a foam shape with an electric mixer, add 1 / 3 of the protein to the cheese sauce and stir well. Stir thoroughly, add the remaining 2 / 3 to the cheese sauce.
6. Pour the cheese sauce into a 2-liter flat-bottom baking pan and bake in a preheated oven at 200 ° C for 12- 15 minutes.

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A computer program is composed of commands that can cause a specific sequence of states within the computer and produce output. In computer science, a sequence of commands to accomplish something is called an algorithm. In other scenarios it may be called recipes or instructions. Intives and algorithms represent the way to complete the task. Most computer algorithms accept data input and produce output for some situations. Both the data and the

algorithm contain information. Data can be considered as a representation of aspects of the external world. In this way, computing is a sequence that uses the method representation (algorithm) to produce an internal representation (machine state) of the representation (data) of a certain aspect of the world, and obtains the final representation (output) [1]. Either representation, it is the physical state of a system, and it can also be understood as information. ”
[7].

“The procedure is the program. The author uses the word "instructions", but this later suggests that he is already using the "computer programs" in analogy to these "directives." It can be seen that the author believes that the tool for describing the laws of complex science is "program" ("instruction" and "calculation", and he has several names of the same meaning in the book, and the word "information".)

Of course, the article does not agree that the author simulates these "instructions" directly with a computer program. Computer program is a computer program, is not a pastry making program, also is not a biological program, is not an economic activity program. The author seems to use the computer program directly as a "custard program."

Johnh Holland also named a concept called "constrained generating procedures" in "Emergence".

" We will follow what scientists often use to move from intuition to precision, and the end result will be a concept that I call a " limited generation process, " that can be used to accu speedly describe a large class of models. Since the genespeedd model is dynamic, I call it a "process";" [8]

Johnh Holland also thought of the "program" approach.

Even the tool of "program" is available in a psychology paper.

“Psychological program is not only the link between mental psychology and body physiology of human beings or other life, but also the link between individual mental psychology and external things. Psychological program is neither a thing in the physiological category nor a thing in the spiritual category. It is a combination of a series of steps in the effect of the spirit (or consciousness) on physiology. In order to perform certain tasks, life bodies need to initiate a series of psychological or physiological activities, which is the process of psychological or physiological activities called "psychological program".” [9]

In this article, the author explicitly stated that "people's psychological activity is programs". Human psychology is a complex system, so the tool of "program" can be applied not only to biology, economics, but also to psychology.

A program is a tool for describing laws, and mathematics is the same level of concepts. Many economic laws are difficult to describe in mathematical equations, but can be described in "programs". Of course, this is not to say that economics is not appropriate with mathematics, the following will use mathematical equations as a model of the speed of money flow.

3.fractal

An economy or a country is a system, and the human body is a system. They are not at the same level, but have similar structures and operations, such as the state has a central government, the human body has a brain, the state has an army, the human body has teeth, hands and feet, the state has a monetary system, the human body has blood, the state has a

political system, people have a character, and so on.

The larger system and the smaller level system within it these structure and function and operation mode similarities are called fractal.

To analyze economic activities by complex scientific methods, we should use a "fractal" model. Treat the entire economy (usually a country) as a human body.

Then, money = blood, government = brain, heart = bank.

If the blood flow on a person's body is not smooth, the body will obviously go wrong. Similarly, the currency operation of the economy is hindered, and the financial crisis occurs.

4. Another formula for the rate at which money flows (Formula for balancing money supply and demand)

There is "supply equilibrium" in economics, so this article puts forward "money supply equilibrium". Unlike the usual "monetary equilibrium", the money supply equilibrium here is for every "node". This "node" refers to the subject through which the money flows, such as a single person, a company, a bank, etc. At both ends of this "node" there are "in" and "out" situations, like water flowing through a joint, and the water on both sides should be roughly balanced.

Because the flow of money at both ends of the "node" is related to the time, a concept of the speed of money flow is proposed here. The speed of money flow refers to the amount of money passing through both ends of a node per unit of time.

By comparing economy to human body, make the following points:

1. The financial crisis is because money flows are blocked or interrupted or the speed difference is too large. And the blocked place is in the "node", and the circulation rate of money at both ends of the node is too different. According to the "money supply and demand balance", the capital flow speed at the two ends of the node should not be too different.

For example, the flow speed of money invested in production and the speed of money flowing by enterprises selling products can not be too different. If the flow of investment and production is faster than the revenue from sales, the company will lose money. Here, the company is the node.

2. The speed of currency flow throughout the country should remain stable, and a sudden interruption in currency flow will prevent citizens to withdraw cash from banks.

The supply and demand of money have the "speed" variable, because "supply" and "demand" take time, therefore, the balance of the supply and demand of money is the equilibrium of the speed of money flow.

Using human individuals or companies as "nodes", the flow rate of money flowing into this node is:

$$v = \frac{M}{t}$$

M is Money flowing out of or into the bank (assuming this "node" is the bank)

The formula means the amount of money flowing into or out of a company or individual at some time. For example, if a bank loans \$10 million in a day, then the flow rate of the loan is:

$$v = \frac{10^7}{t} = 10^7 / \text{day}$$

A person's monthly salary is \$1,000, so the speed of his salary flow is:

$$v = \frac{10000}{t} = 10000 / \text{month}$$

The rate of money flow is calculated as the amount of money flowing in or out of the "node" per unit of time.

If a bank, excluding reserves, it has \$100 million, in a month, it lent \$10 million to the customer who bought a house, assuming 10 people, 1 million each. If each of the ten customers pays \$10,000 a month, the total is \$100,000. Ignoring interest, there is still \$9.9 million, and \$9.9 million needs to be made up from other sources.

If this bank, someone withdraw 90 million dollars a month, Then its \$100 million is just enough. (Regardless of bank profits and employee salaries) If the first 10 customers who borrow money to buy a house have a person who did not repay that month, then obviously, the bank's working capital is a problem, because some depositors can't get any cash.

The flow of money flowing out of the bank should be roughly the same as the amount flowing in, so that no run occurs. In the above example, if a house buyer does not pay back the money that month, then the amount of money inflow from the bank does not equal the amount of money outflow. Therefore, banks need to pay attention to the currency flow of the person who borrows money and whether they have enough income.

Here, there is an equilibrium, namely: the equilibrium of money flows. At both ends of the outflow and inflow of a "node", the amount of money flow should be close to equal. Like the "node" of the bank, like the individual, or like the "node" of the company.

The supply and demand here do not refer to the supply and demand of the whole country, but refers to the "node", this node can be an individual, can be a company, can be a bank, etc

$$\frac{M_g}{t} = \frac{M_x}{t}$$

M_g It's the supply of money, such as a worker's income;

M_x Is the amount of money needed, such as how much money a worker needs to buy goods.

Here, of course, demand and supply are at the same time.

For example, I need \$1,000 to buy a computer, but I only have \$100 in my account, so I hope I have \$900 this month, my demand is for \$900, otherwise I can't afford a computer, and I have a financial crisis.

For a bank, in a period of time, the money it borrows is demand, and the depositor deposits to the bank is supply, the two needs are roughly equal, this is "monetary equilibrium".

The monetary amount of this formula needs to be superimposed. For example, the above 10 people who borrow money to buy a house will repay the money in one month respectively:

$M_1, M_2, M_3, \dots, M_{10}$, The speed at which the currency flow is calculated is:

$$v = \frac{M_1 + M_2 + M_3 + \dots + M_{10}}{t}$$

This formula for the rate of money flow is often used in the economy. For example, the bank calculates how much money is lent out over a period of time, how much the depositor saves in the bank, and how much money the borrower pays back.

The mistake the Bank of America made in 2008 was not to timely check the income of people who borrowed money to buy a house, that is, not watching the speed of their currency flows, this has caused the banks' money supply and demand to lose their balance.

The reason for the Great Depression of 1929 was that more money was invested in production than money for consumption (the stock market was hot, the money in the stock market was invested in production). Set: the money used for investment production M_s , the money used for consumption M_x , time is the same.

5. The rate of money flow in the overall economy

The above formula is the speed in an economy such as individuals or companies or banks. Now look at the speed of currency flow in the whole country:

$$D = \frac{M_b}{M_a}$$

$$v = \frac{D}{t}$$

Among them, M_a is the currency printed by a country, usually paper money, M_b is the currency on the accounts of all nationals, companies, etc. M_b is means money, excluding non-monetary property. For example, a company's property is \$10 million, but its capital is only \$1 million, and the others are machinery and factory buildings and land assets, so, then M_b is a million dollars. The formula means that the currency printed by a country is divided by the currency property owned by all its nationals, companies, etc., and then divided by the time like a year, which is the rate at

which the currency of the country flows. The higher the speed, the less cash the citizens have when a financial crisis occurs. For example, the country actually printed \$1 trillion dollars, but last year, citizens and companies had \$10 trillion dollars in monetary assets in their bank accounts, So the rate at which the country's currency flows is: $10 / year$.

6.Cause of the financial crisis

In the past, many people explained the economic crisis with the view of "overproduction", and the essence of overproduction is also that the rate of money flow is too different. Business owners invest too much in production because money flows too fast, while workers have low income levels, and they spend less than money than companies invest. So, the product is surplus.

There are also theories that the economic crisis is because wealth is too concentrated, that is, the rich have too much wealth, but the money they spend is not proportional enlarged. But that is also a matter of the just how fast money flows.

A bank run involves more money outflows than inflows.

The more important reason for the 1929 US financial crisis was the rupture of the bank capital chain. Exflows money from banks much faster than money flowing in.

Bank of America couldn't collect its money, especially after the stock market collapsed. There was a run on the banks (The inflow and outflow speeds are not equal), Banks' capital chain broke, and thousands of banks failed. When banks fail, the speed of money flow is zero. Lower money flows makes less money available, and the faster it flows, the faster money flows, the less dollars people are in hand when it decreases. So the people ran out of money, and the Great Depression happened.

The subprime crisis in 2008 was also this. The speed of bank loans has been increased several times in several flow nodes, and the bank's money flows out much faster than that flowing in.

From these crises, the most critical and essential variable is the "speed of money flow". The speed the money movement, the more people are short of money once banks fail.

A new concept different from "equilibrium": the circulation of money cannot be hindered or discontinuous.

For example, the money of a bank, the bank has a lot of money, it has to lend to customers, similarly, if the bank's money is lent, it has to have money saved, like water in the water pipe, that water can't be congested but it can't be cut off. The wealth of the rich is the same, the rich are very rich, they should consume, otherwise the money will be congested with them, their money is spent, they must have income, otherwise they will not be able to live.

Another concept of "water pressure": in the node of money flow, when the wealth of this node is greater than the average wealth of the society, the "water pressure" at the entrance of the node, should be smaller than the exit of the node. This "water pressure" refers to the speed of money flow. On the contrary, when the wealth of this node is less than the average wealth of the society, the currency flow speed of the node entrance should be greater than the currency flow speed of the node export.

The equilibrium of the rate of money flow is the most important among banks, because if they fail, it is an economic crisis. But imbalances in the flow of individuals and companies is not necessarily fatal, it is a personal disaster. This can be compared to the human body, the bank is like the heart, once the heart dies, the person dies. Enterprises and individuals are equivalent to the limbs of the human body, even if destroyed, it is not necessarily fatal. Therefore, caring about the speed of the money flow of the banks is the most important.

Also to focus on is the speed of money flow related to "supply and demand," and the speed of money used for investment production and the flow of money used for consumption should be balanced, otherwise the Great Depression of 1929.

7. Based to the above view that money should flow evenly (equal), build an equation:

$$\frac{M_s}{M_z} = \frac{M_x}{Q}$$

On the left and right sides are the speed of money consumed and the speed of money used for production.

M_z Number of printed notes (economic property, usually anchored by gold)

M_x The flow of money spent for consumers

M_s the flow of money used to produce goods

Q The total value of all goods in the economy

(Note: Flow contains time t)

When the equation stabilizes, the economy is stable.

At this time, supply and demand balance, there is no overproduction.

In general, M_z when it increases, Q it also increases. Or M_x increase, Q it will increase. And

Q increase, M_s it will increase. (This is determined by human nature, more money, prices will

rise. The more people buy goods, the price will rise. And Q increase, producers will want to

expand their capacity to produce more goods, this is also human nature. In the analysis here, the "programs" are used, and these "laws" are all programs.)

If Q it increases and M_s increases, but M_x does not keep up with the change, the central bank will raise interest speeds to avoid overheating and overproduction.

Managers should regularly check the speed of money flow throughout the economy and promptly intervene in abnormal local flows. Flow flows too fast, for example, during the 2008 US subprime mortgage crisis, banks lent money much faster than customer income.

When the speed of money flow suddenly decreases because of certain factors, the individual's money decreases or even disappears. Because his deposits had been in his hands when money was flowing rapidly, there was not so much paper money. As a result, once the flow speed of economic currencies is stable and uniform everywhere, it cannot easily slow down.

Of course, before that, the business had been too expanded, consumer fever, out of the "Coolidge boom". At this time, the currency flow speed of various enterprises and companies has been too fast, and other industries may not keep up. For example, borrowers can't keep up (so banks lend them), and agriculture does not. That is to say, at this time, the enterprise, corporatespeed currency flow speed is much higher than other industries. But when the currency flow has formed and drives other links, such as raw material suppliers and consumers. At this point, if the Fed adds more interest, it will break their capital chain, and have no money. That's

because there hasn't been so much paper money, it's all the high money flow that gives them so much money. The higher the money flows, the more money it disappears when it slows down.

So, the speed of money flow is important, and in one link is there that doesn't keep up, and the whole economy fails, such as agricultural income.

The speed of money flow across the economy depends on the slowest link, like a bucket holding water, and the water level depends on the shortest board.

If the manager cannot increase the slowest currency flow speed, it is necessary to reduce the currency flow speed where the speed is too high, but the reduction speed should not be too intense, but to move slowly.

In 1929, when the Federal Reserve raised interest rates, bank lending, businesses and consumers were already high. A violent interest rate hike will only accelerate the financial crisis. Interest rates should be raised when money flows are low, so that companies and consumers will not be too short of money. Similarly, reducing the circulation speed of a certain link of money should also be carried out when its speed is low, if it is already running at a high speed, it must be careful.

Of course, the Fed had tried to reduce the stock market investment frenzy before the Great Depression, but for other reasons, this purpose has not been achieved.

The speed of money circulating in the article includes how fast banks borrow, how fast companies invest in production, and how fast individual consumers spend money. The individual consumer is equivalent to the human capillaries, and his currency flow is equivalent to the blood flow in the capillaries. The bank is like a heart or an artery.

These speeds the difference should not be too big to be healthy, namely:

These speeds, the speed gap should not be too large, for example, if the banks lend money to the workers faster than the speed of the workers' income, then the bank can not recover the loans in time

The currency flow speed is divided into outflow speed and inflow speed, when the Ms in the calculation formula are the property of the same subject. Therefore, because the property of the subject is different, the same amount of money is different relative to their flow speed. For example, the farmer's property is 10,000 yuan, he gets 1 yuan, the bank property gets 1 trillion yuan, it gets 1 yuan, the flow speed of money is different.

In the United States, banks often lend more than other speeds, such as workers' incomes. Some borrowers are not even able to repay the loans, is "zero". In this way, the circulation speed of money is extremely uneven, easy to cause the bank's capital chain fracture, and then cause the financial crisis.

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